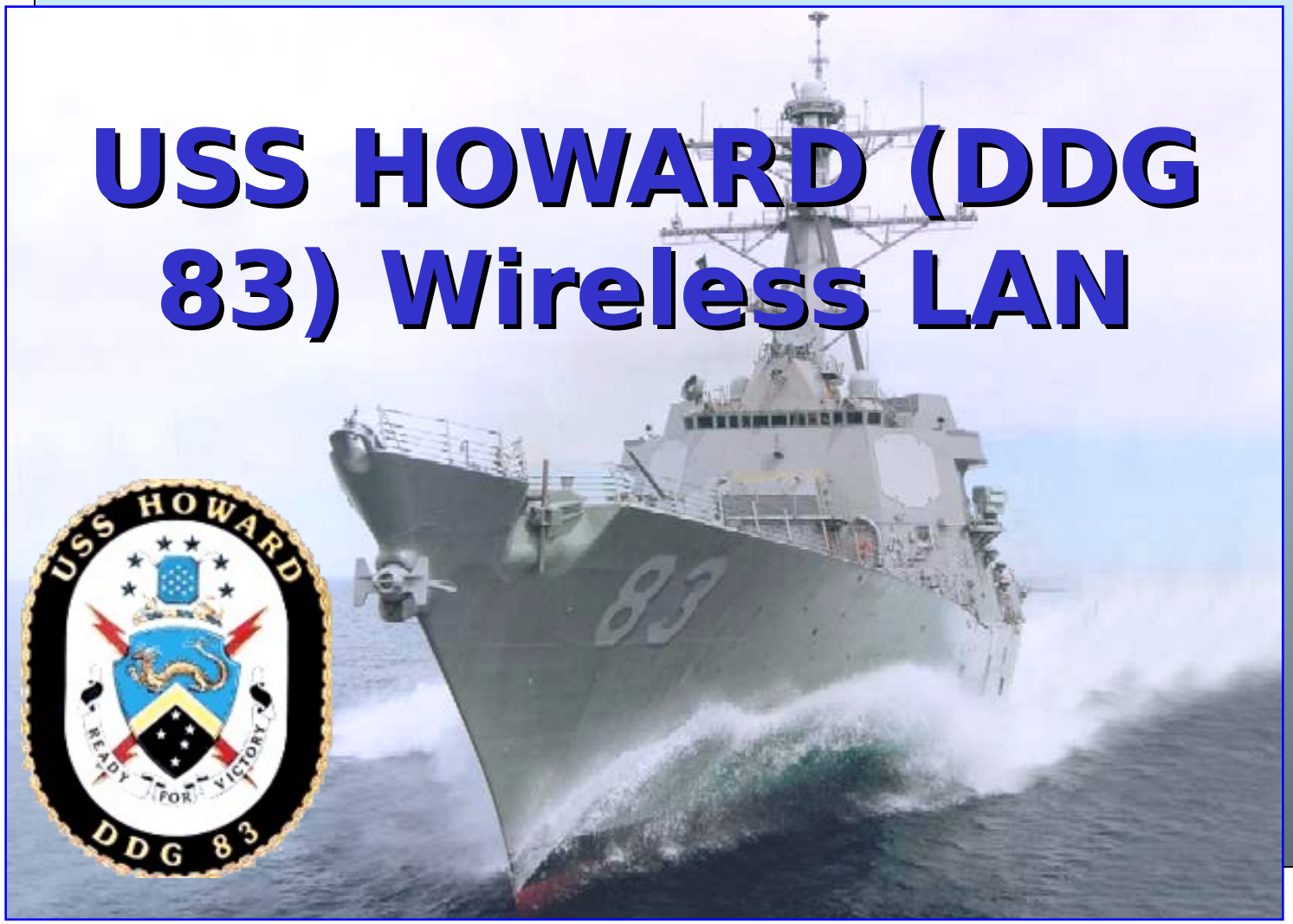
USS HOWARD (DDG 83) Wireless LAN



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Project Goals

- **Provide Wireless LAN (WLAN) coverage in all interior spaces**
- **Joint effort with NAVSEA PMS400 and PEO TSC Smart Ship Program**

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Project Goals

- PMS400D desired a solution for legacy PED connectivity to ISNS
- Originally looking for PDA IR connectivity solution but expanded to include laptops and other portable electronic devices
- Smart Ship desired to field WLAN infrastructure to facilitate Total Ship Monitoring capability

Project Goals

- Provide wireless access to USS HOWARD's UNCLAS LAN (ISNS)
- Access to LAN applications in previously inaccessible locations
- Facilitate use of Personal Electronic Devices (PEDs): laptops, PDAs, handheld and wearable PCs
- Eliminate need for additional shipboard LAN drops (significant cost savings)

Description

- **Implementation Plan**
  - **Pre-install Wireless Shipboard Survey**
  - **WLAN Architecture Design/Development**
  - **WLAN Hardware Design/Development/Testing**
  - **US Navy Certification & Appro**
  - **Installation and Checkout**
  - **Shipboard Test and Evaluation**

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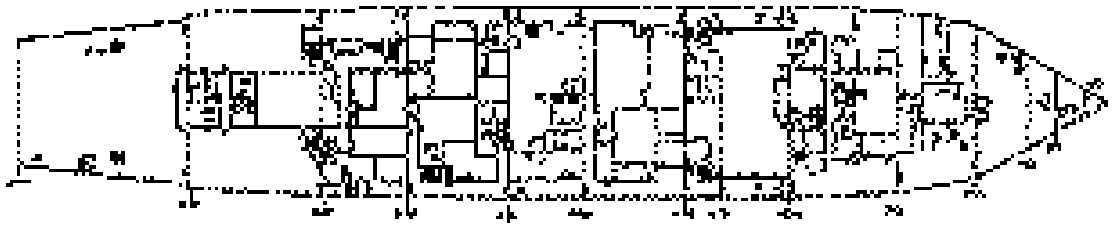
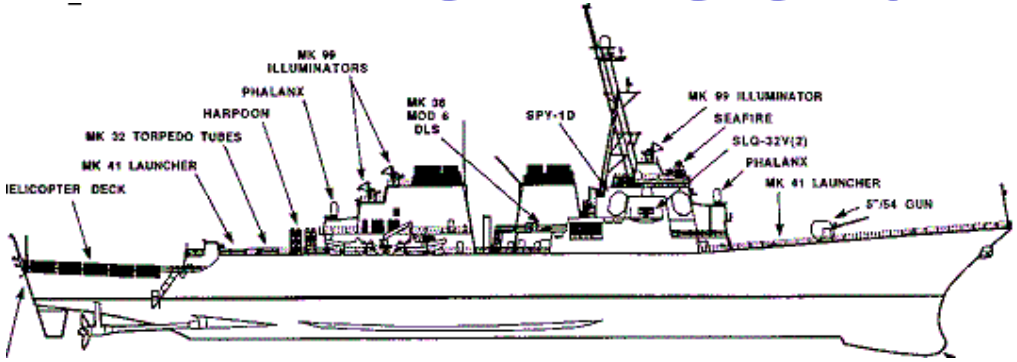
WLAN Survey

- Conducted July ’01 prior to USS HOWARD commissioning
- Preliminary work included review of ship drawings to determine gateway locations
- Survey team spent one week on board HOWARD verifying and adjusting optimum placement of gateways



WLAN Architecture



- Post wireless survey, developed WLAN Architecture
- Collaborative effort: 3eTI/Aeptec Microsystems, PMS400, & Bath Iron Works
- (40) 3e-521N Wireless Gateways distributed ship-wide provides coverage for 99% of interior compartments and spaces

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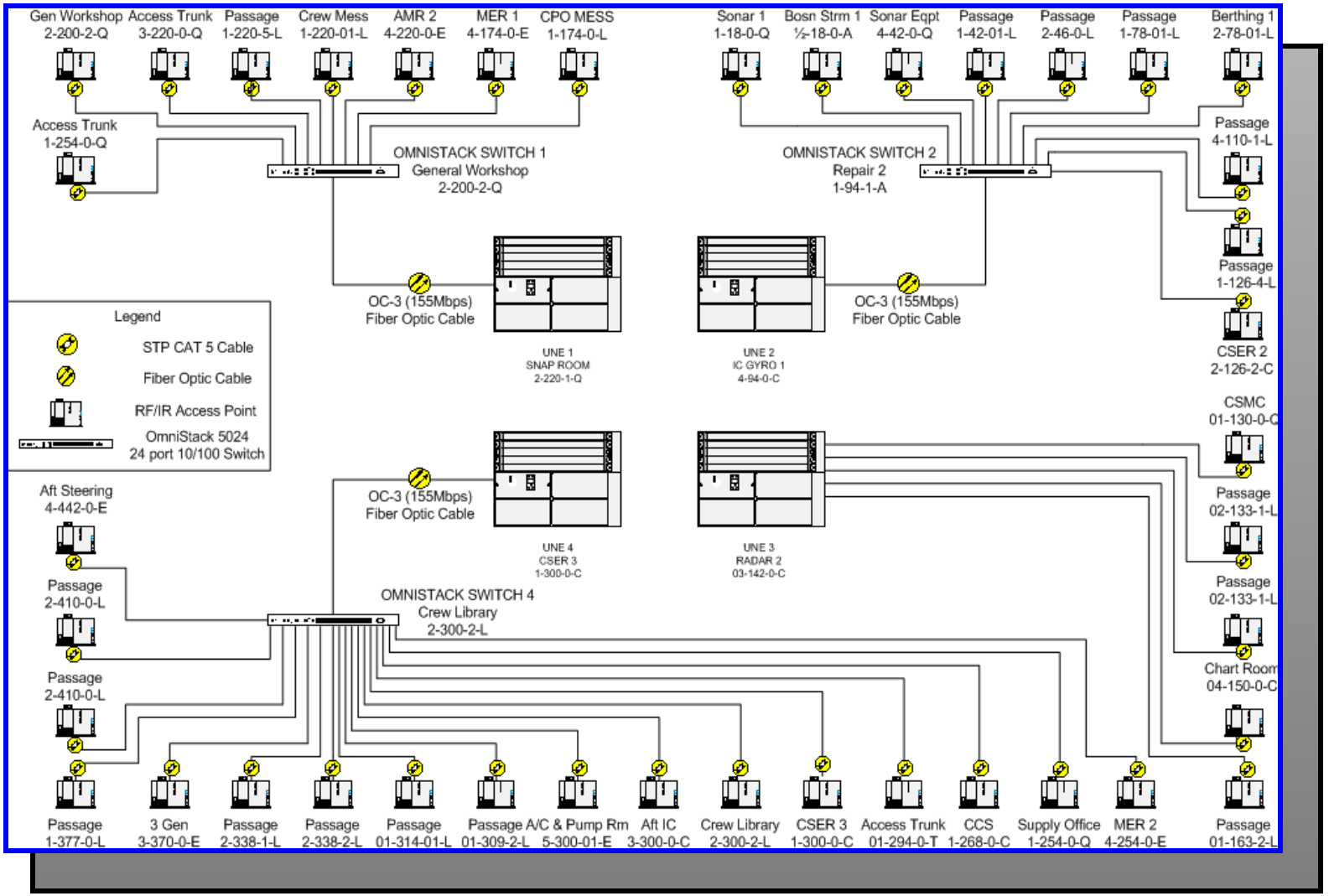
WLAN Architecture



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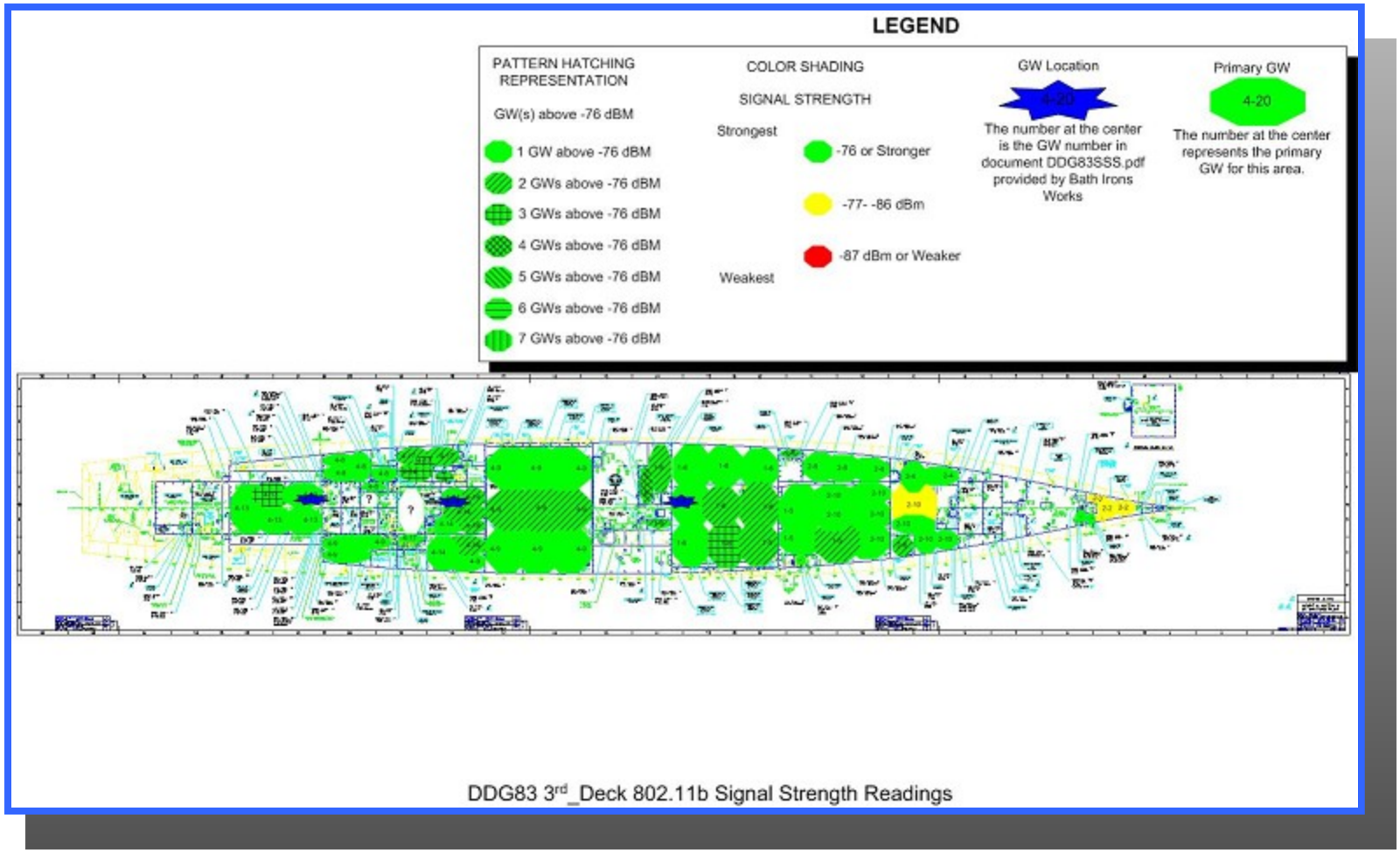
DDG83 – Signal Strength


LEGEND
PATTERN HATCHING REPRESENTATION
GW(s) above -76 dBM
1 GW above -76 dBM
2 GWs above -76 dBM
3 GWs above -76 dBM
4 GWs above -76 dBM
5 GWs above -76 dBM
6 GWs above -76 dBM
7 GWs above -76 dBM
COLOR SHADING
SIGNAL STRENGTH
Strongest
-76 or Stronger
-77- -86 dBm
-87 dBm or Weaker
Weakest
GW Location
The number at the center is the GW number in document DDG83SSS.pdf provided by Bath Irons Works
Primary GW
4-20
The number at the center represents the primary GW for this area.
DDG83 3rd_Deck 802.11b Signal Strength Readings

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WLAN Hardware

Dual Mode 3e 521N Wireless Gateway

- IEEE 802.11b
- IrDA
- Conventionally powered (standard 115v AC)
- Splash-proof NEMA approved Hoffman enclosure
- Shipboard Environment Qualified

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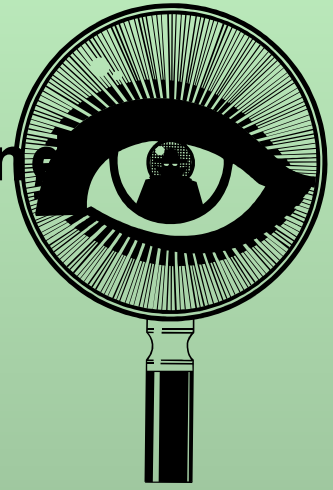
WLAN Hardware

- **Successfully completed NAVSEA set of shipboard environmental qualification tests prior to installation approval**
  - **MIL-S-901D Lightweight Shock**
  - **MIL-STD-167 Vibration**
  - **MIL-STD-451E EMI Emissions and Susceptibility**
  - **MIL-STD-810F Humidity**
  - **FCC Part 15, Subpart B**



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WLAN SECURITY

- **Original Security Features**
  - **128-bit WEP Encryption**
  - **802.11b Broadcast Mode disabled**
  - **Shared Key Authentication**
  - **SSID**
  - **MAC Address Filtering**
- **Upgrade features being implemented in 01/03 to comply with DoD Wireless Policy**
  - **FIPS 140-2 Advanced Encryption Standard (AES) to strengthen confidentiality, access control and data integrity (Hardware based)**
  - **Dynamic AES key exchange algorithm at AP (software based)**

Navy Certification & Approval

CINCLANFLT & SPAWAR controls connections to shipboard LANs

- **Requires Afloat Network Compatibility Testing**
- **Successfully completed in December ’01**

3e-521N Wireless Gateway approved for connection to Afloat Network

- **SPAWAR SSIL-02-0347**

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Navy Certification & Approval

- **Interim Authority to Operate (IATO) requires approved DITSCAP & SSAA**
- **Short-term approval granted for IATO**
  - **Granted 1 YEAR extension at end of HOWARD SCN window in 10/02**
- **Full-up Approval underway**
  - **Requires implementation of newly FIPS 140-2 mandated security requirements (AES or VPN IPsec)**
    - **Revised HOWARD WLAN security architecture complete**

Navy Certification & Approval

DD 1494 in process

- Approval granted for 3e-521N and PCMCIA RF LAN Cards
- NAVEMSCEN circulating to Host Nations

- **HERO & HERF Certification**
  - ***"HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE (HERO), PERSONNEL (HERP), and FUEL (HERF) SYSTEM CERTIFICATION FOR UTILIZING 3eTI WIRELESS SERIES GATEWAYS AND WIRELESS PCMCIA LAN CARDS ONBOARD ARLEIGH BURKE-CLASS SHIPS"***
  - **10 ft separation from susceptible ordnance, devices and materials**

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Installation and Checkout (INCO)

- **(40) 3e-521N Wireless Gateways installed on USS HOWARD - Jan ’02**
- **INCO and Wireless Coverage and Throughput Testing**
  - **Pier-side in stand-alone mode (no shipboard LAN connection)**
  - **At-sea fully operational (connected to USS HOWARD ISNS LAN)**

Shipboard Test and Evaluation

- **EMI Far Field Emissions and Susceptibility tests successfully completed in Feb ’02 at Pacific Missile Test Range**
- **Additional T&E planned**
  - **WLAN FIPS 140-2 AES Coverage and Throughput**
    - **Necessitated by planned upgrade (3e-521N) and implementation of FIPS 140-2 solution**
  - **Informal investigations and assessments planned by PMS400 (related mainly to WLAN applications and end-user wireless devices)**

WLAN Throughput & Coverage

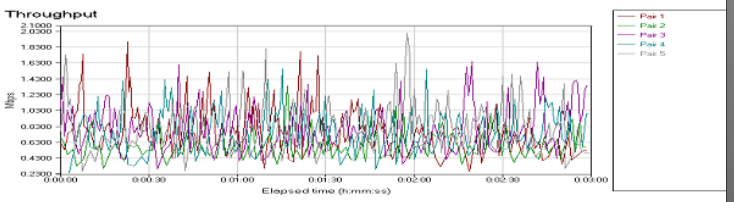
01-130-0-Q_CSMC

In the Space 01-130-0-Q_CSMC, our throughput tests revealed an average throughput of 3.408Mbps for all test stations. Our test methodology included five end stations, as shown in the figures below, executing the procedures in our test plan (attached in Appendix xx). Throughput values, for each end station, varied from a low value of 0.247Mbps to a high value of 2.005Mbps.

Based on the coverage readings and throughput results, this compartment is adequately connected to the WLAN.

Throughput

Group/ Pair	Average (Mbps)	Minimum (Mbps)	Maximum (Mbps)	Throughput 95% Confidence Interval	Measured Time (secs)	Relative Precision
All Pairs	3.408	0.247	2.005			
Pair 1	0.690	0.261	1.900	0.043	178.431	6.293
Pair 2	0.556	0.300	1.340	0.027	178.315	4.882
Pair 3	0.747	0.294	1.653	0.042	178.848	5.643
Pair 4	0.690	0.247	1.559	0.043	176.183	6.295
Pair 5	0.749	0.267	2.005	0.047	179.480	6.309
Totals:	3.408	0.247	2.005			



- **All compartments Surveyed**
- **Multiple Client stations (1–5)**
- **Overlapping AP coverage**
- **Avg/Min/Max Mbps readings**
- **Confidence/Time/Precision calculations**

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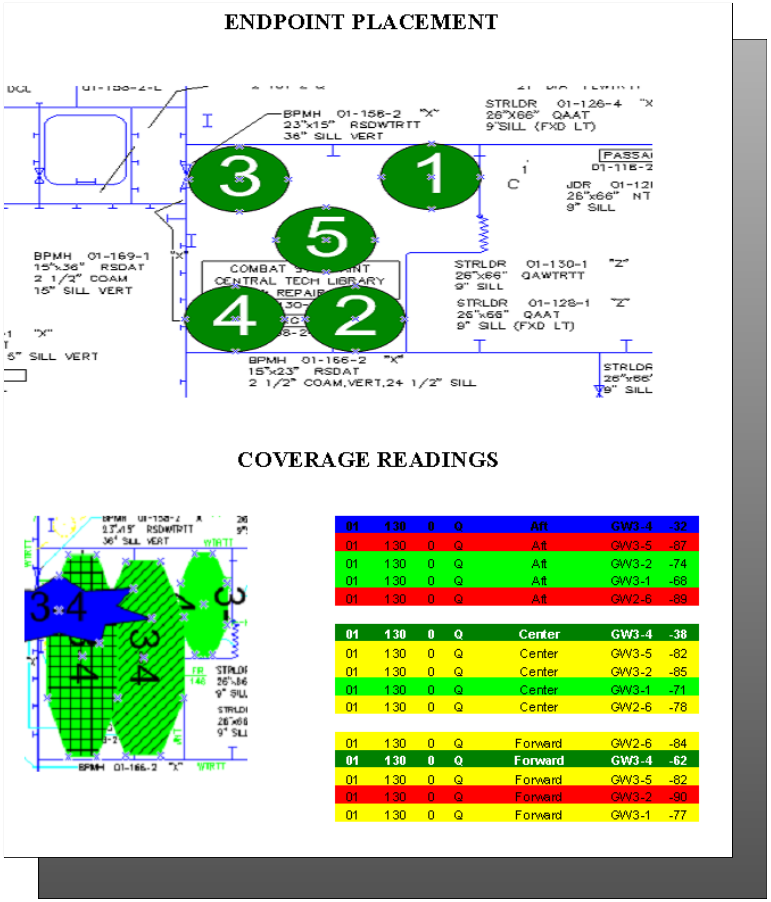
WLAN Throughput & Coverage

- ~90% of ship has WLAN access
- 65% of the WLAN areas have secondary AP coverage
- 40% have tertiary coverage


ENDPOINT PLACEMENT
COVERAGE READINGS
01 130 0 Q Alt GW3-4 -32
01 130 0 Q Alt GW3-5 -87
01 130 0 Q Alt GW3-2 -74
01 130 0 Q Alt GW3-1 -68
01 130 0 Q Alt GW2-6 -89
01 130 0 Q Center GW3-4 -38
01 130 0 Q Center GW3-5 -82
01 130 0 Q Center GW3-2 -85
01 130 0 Q Center GW3-1 -71
01 130 0 Q Center GW2-6 -78
01 130 0 Q Forward GW2-6 -84
01 130 0 Q Forward GW3-4 -62
01 130 0 Q Forward GW3-5 -82
01 130 0 Q Forward GW3-2 -90
01 130 0 Q Forward GW3-1 -77

- Average throughput 3.0 – 3.5 Mbps including thick bulk heads

WLAN Applications

Current Wireless Applications

- 50 wirelessly enabled laptops to connect to the DDG 83 unclassified LAN (ISNS)
- GOTS D load access to resident data & applications
  - MS Office, email, Web connectivity, etc.
- Distance Support's Remote Technical Assist Support System (RTASS)
  - laptop PC, camera and video compression software
  - enables untethered communication to shore support infrastructure to resolve technical maintenance issues

WLAN Applications

Potential Wireless Applications

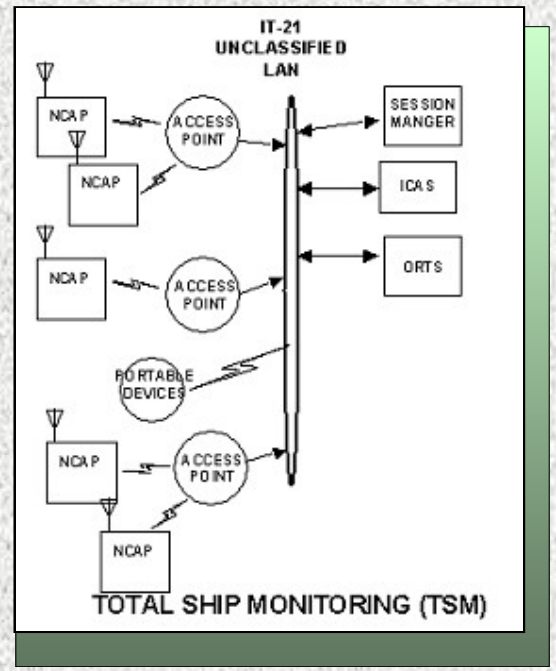
- **Total Ship Monitoring (TSM)**

- New Development (3e-550I W-LION, 3e-521N Series Gateways) plus existing shipboard equipment and Systems

- Wireless data collection, monitoring & analysis of the condition of a vessel's Hull, Mechanical & Electrical equipment and the operational readiness of selected Combat System equipment

- Provides capability to perform diagnostics and prognostics on the systems and equipment being monitored

- Shares the results of raw and processed



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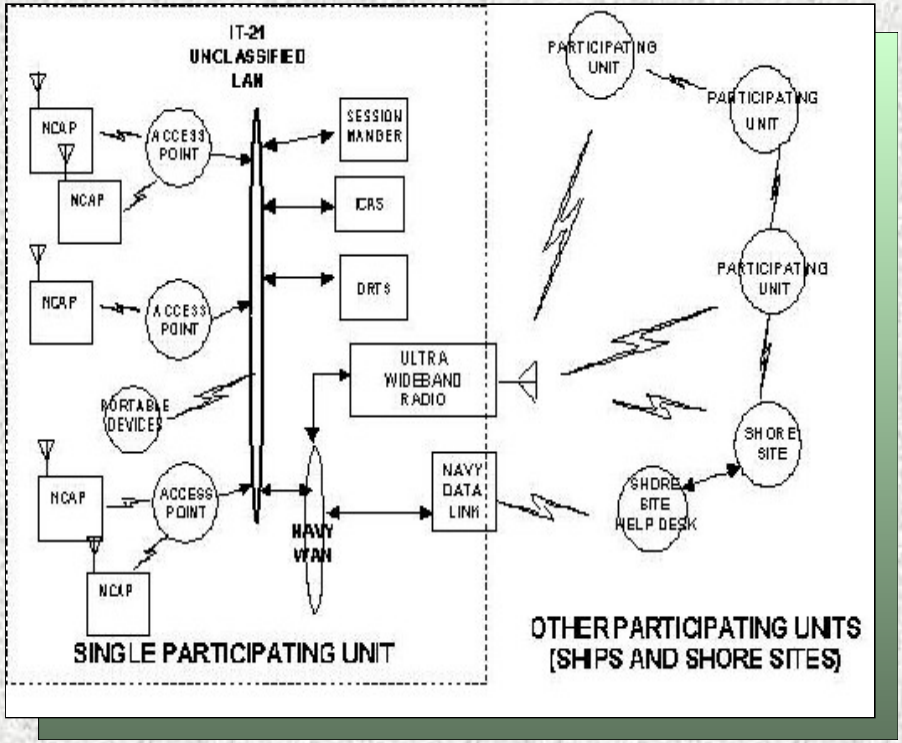
WLAN Applications

Potential Wireless Applications

- Application:
  Automated Maintenance Environment (BG-AME)
  - New Development (3e-550I W-LION, 3e-521N Series Gateways, Session Manager) plus existing equipment & Systems
  - Wireless collection of data reflecting the condition of vessel's HM&E equipment
  - Share data results with other systems in the ship
  - Provides processed data with other ships in a BG and/or ...



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